SWORN

TRANSLATION

I, the undersigned, a Sworn Public Translator and Commercial Interpreter in and for the City of Rio de Janeiro, State of Rio de Janeiro, Federative Republic of Brazil, appointed by Executive Decree, hereby C E R T I F Y that a document written in PORTUGUESE has been presented to me for translation into ENGLISH, which I hereby do by virtue of my appointment and in compliance with the request of the party concerned, as set forth hereunder:

TRANSLATION NO. 6427-99

(Weapons)

FEDERAL REPUBLIC OF BRAZIL

Ministry of Industry, Trade and Tourism

National Industrial Property Agency

ARMANDO DE FRANÇA E SILVA
RIO DE JANEIRO
TRADUTOR PÚBLICO

LETTERS PATENT # PI 9300292-0

Invention Privilege

The National Industrial Property Agency, with a view to insuring property rights and the exclusive use of a privilege, pursuant to the attachments, and in consonance with laws in force, and preserving third party rights and Government responsibility vis-à-the novelty and the usefulness, herewith issues the present **Letters Patent,** pursuant to features and conditions hereinunder set forth:

(21) Number of Deposit: PI 93000292-0

(22) Date of Deposit: 27/01/1993

(43) Date of Publication of Submission: 16/08/1994

(51) Int'l Classification: E21B 34/06

(54) Title: **IMPROVED NOZZLE VALVE SEATS**

(73) Owner: Petróleo Brasileiro S/A - Petrobrás, Mixed Economy Corporation

CGC/CPF: 33000167081942. Address: Av. República do Chile no. 65, 24th fl., Rio de Janeiro, Brazil, So.Amer., (BR/RJ).

(72) Inventor: Alcino Resende de Almeida, Engineer, CGC/CPF: 71480366749. Address: Rua Mariz e Barros, 572 apt. 505, Maracanã, Rio de Janeiro, Brazil.

Citizenship: Brazilian.

Period of Validity: 20 (twenty) years as of 27/01/1993, with observance of legal stipulations.

Issued 24 November 1998.

signed illegible

Maria Margarida R. Mittelbach

Director, Patents Div.

signed illegible

Carlos Pazos Rodriguez

chief, SAAPAT

P.I.9300292

Description of Invention: "**Improved Nozzle Valve Seats**".

BACKGROUND OF THE INVENTION

The present invention relates to improvements in nozzle valve seats, utilized in oil wells producing pursuant the continuous gas lift procedure.

DESCRIPTION OF PRIOR ART

In oil wells producing pursuant to continuoous gas lift procedure, for well operations one commonly utilizes a valve normally named "**nozzle valve**". Gas originating from annular space between cover - production line for the latter - flows thru said valve. Said gas is responsible for well production pursuant to a given flow rate.

Nozzle valves are basically composed of a nozzle with diameter previously determined (also named seat or door) without changes in same as

long as valve is located within well area. Gas flow thru said nozzle features a high degree of irreversibility, thus promoting an expressive loss of cargo, in addition to rendering difficult gas flow rate calculations admitted for passage thru same unit, thus compounding both project and analysis.

SUMMARY OF INVENTION

In consonance with the present invention, an improved seat of this type of valve is proposed, utilizing optimized geometrical seat features, according to which gas flow within valve will resemble an isoenthropical flow, considerably cutting down side effects effects already expressed in the earlier geometry. This new proposal is based on the utilization of the so called "compact venturi", which implies in coupling of a convergent mouthpiece with a conical diffuser unit. Said device is nearly as efficient as a traditional venturi unit, being however shorter (which is required in the case of

a valve) and being considerably easier to manufacture, thus offering lower cost features.

Utilization of this geometry will enhance an increment of roughly 20% in viable gas flow rate thru valve vis-à-vis an identical pressure offset between covering and line, or, on the other hand, will imply in a 76% - 20% decrease in cover pressure required to handle identical gas flow rate with identical line pressure (the most common cases should be close to the upper range value).

A striking example, evidencing the adequacy of said new valve described herein is the case of deep water satellite wells, where a host of large flow rates with high pressure levels is present.

SHORT DESCRIPTION OF DRAWINGS

The invention will now be described in more detail, based on the attached drawings, featuring:

Figure 1 - partial cut view of nozzle valve of type now utilized with enlarged detail, featuring cut of seat;

Figure 2 - schematic view of detail of seat, featured in detail;

Figure 3 - schematic view of detail, featuring cut of seat, illustrating gas flow thru same; and

Figure 4 - enlarged, schematic cut view of improved seat, utilized in nozzle valve.

DETAILED DESCRIPTION OF INVENTION

Figure 1 evidences a nozzle type pneumatic lift valve seat, currently utilized. Figure 1 evidences point designated "A", indicating gas admission to inside valve section, flowing thru seat (specifically, the nozzle) "B" and escaping thru nose section "C" towards tube inner section. The same figure 1 outlines a detail of cut of said seat, schematically reproduced in Figure 2, where a valve cylinder body 1 can be noticed, the seat housing 2, seat 4, nozzle 4 and 0-ring 5.

It can be seen that seat 3 is simply a disc unit with a cylindrical straight hole pursuant to diameter desired. General edge shaped sections are sharp, but there are cases in which a small bevelled section 66 is foreseen.

Figure 3 features a flow line scheme thru nozzle 4, pursuing a path thru seat 3. Sudden contraction and expansion features cause vortexes originating intense loss of load. In addition, the smaller flow area does not occur along the restricted section (seat), but farther ahead, pursuant to a phenomenon called "vena contracts".

Conventional modelling feature consists in presupposing isenthropical escape (reversible adiabatic), with final integration of a correction coefficient (discharge coefficient) and theoretical results are being compared with experimental results. Neverthelsss, said discharge coefficient is difficult to be expressed, since it is contingent upon several factors, many being intangible and based on a theoretical modelling viewpoint. Subsequently, project and the continuous gas lift procedure

are being handicapped, since these are contingent upon correct gas flow rate calculations thru valves. On the other hand, irreversibility factors imply in extra load losses in system (which unnecessarily are changed into heat).

With a view to minimizing problems outlined above, according to the present invention a novel geometry is being proposed for seat 7, shown in an enlarged schematic cut view in figure 4.

The improved seat 7 features an upper curved section 8, an intermediate vertical straight section 9 and an inclined lower straight section 10 with central spacing 11 representing a first section, featuring a format of a convering mouthpiece wherein gas is gradually being accelerated, a second portion 13 which is a cylindrical section of equal diameter of desired nozzle and corresponds to main flux restriction, and a third section 14, evidencing a conical diffuser format, wherein gas is gradually being decelerated. With these measures, irreversibilities are reduced and the lower flow

rate area coincides with the second section 13, avoiding said "vena contracts".

The α angle defining length h_1 of the thrid section 14 is restricted by length available (which is more critical for 1 1/2" valves, unless changes are being effected in valve body). diameter d_1 may coincide with d_α, however, generally, due to assembly aspects, it should be slightly inferior. In the same way, a second portion 13 may be theoretically reduced to a simple section, however - also due to practical questions - should always feature a certain length $h\alpha$, even of small extent, with $h\alpha$ representing the length of the first section 12 with outer contours resembling a convergent mouthpiece.

In applicable literature, said unit is often called "compact Venturi", since it resembles the common venturi, being much shorter though and easy to manufacture, but does not evidence remarkable performance levels.

C l a i m s

1. Improved nozzle valve seats used in oil wells pursuant to a continuous pneumatic gas lift operational feature, consisting of a cylinder shaped body (1) into which gas flow is admitted thru an intermediate nozzle (A), passing thru seat (B) and being discharged in lower section thru nose setion (C), characterized in that said improved nozzle valve seat comprises a seat (7), featuring a curved (8) upper section, a straight vertical section (9) and an inclined lower straight section (10) with central spacing (11) representing a first section (12), with a format similar to a convergent mouthpiece in which gas is gradually being accelerated, a second section (13) corresponding to main flow restriction feature, as well as a third section (14) similar to a conical diffuser unit in which gas is gradually being decelerated.

A B S T R A C T

Description of invention: "**Improved nozzle valve seats**".

The present invention relates to improved nozzle valve seats used in oil wells with a continuous gas lift production feature, compromising a seat (7) featuring a curved upper section (B), a vertical straight section (9) and a straight inclined lower section (10) with central spacing (11), representing a first section (12) similar to a convergent mouthpiece, in which gas is being gradually accelerated, a second section (13) corresponding to main flow restriction feature, as well as a third section (14) similar to a conic diffuser unit, in which gas is being gradually decelerated.

Rio de Janeiro, August 23, 1999.

WITNESS MY HAND AND SEAL.